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EVALUATION METHODS AND CRITERIA FOR SHORTLISTING ALIGNMENTS

HAMILTON-WENTWORTH RAPID TRANSIT PROJECT

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For Submission By: Metro Canada Limited

To: The Regional Municipality of Hamilton-Wentworth

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MCL Report HW-1-4.0
Part of Task 4.8
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March 12, 1981

Mr. M.M. Ross
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Dear Mr. Ross:

Subject: Report HW-1-4.0
Evaluation Methods and Criteria for Shortlisting Alignments

We are pleased to submit final report HW-1-4.0, Evaluation Methods and Criteria for Shortlisting Alignments. This report is submitted in accordance with the requirements described in Task 4.8 (Sub-section 4.8 of Schedule A to the UTDC - Region Pre-implementation Program Contract). This report has been prepared under Metro Canada direction by M.M. Dillon Limited.

The evaluation method described in this report has been discussed with the Region at the workshops and at the Technical Committee, and you were provided with the shortlisting criteria prior to undertaking the evaluation of the alignment segments with the senior Regional staff.

This report describes in detail the process by which Metro Canada evaluated the alignment segments and arrived at the four selected alignments that we recommended for further study. We have enclosed with this letter one bound copy for your use, and one unbound copy suitable for reproduction.

Very truly yours,

P.J. McCann
Project Manager

PJM:jp

cc: C.T.C. Armstrong

Encl.

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EVALUATION METHODS AND CRITERIA FOR SHORTLISTING ALIGNMENTS

1.0 INTRODUCTION

The purpose of this document is to refine the evaluation methods to be used in the shortlisting of alignments. It is also intended to document the process by which the criteria for the comparative analysis of feasible alignments were selected from the preliminary list contained in the Evaluation Framework and Preliminary Criteria Report.

A general overview of the evaluation process, from the formulation of system goals and objectives to the selection of a recommended alignment, was presented in the Evaluation Framework and Criteria Report. The methods and criteria described in this document concern evaluation procedures envisioned for the shortlisting of alternative alignments. As such they represent an extension of the criteria and methods, both employed in the analysis of possible alignments and the generation of Feasible Alignments (Task A2) and contained in the Evaluation Framework and Preliminary Criteria Report (Task C2).

2.0 GENERAL EVALUATION METHODS - SHORTLISTING

2.1 Subareas

In the Evaluation Framework and Preliminary Criteria Report it was suggested that the selection of criteria would be simplified if the study area were divided into subareas. The Task A2 report reflects this suggestion with the division of the study area into three main subareas; the downtown area, the escarpment area and the mountain area. It is suggested that these subareas be maintained (although the boundaries between the escarpment area and the downtown area have changed substantially in the process of identifying alignment segments) for the shortlisting process, as it is apparent from the A2 documentation that the types of benefits and impacts will vary substantially among the three subareas.

2.2 Level of Detail

It was indicated in the Evaluation Framework and Preliminary Criteria Report that the level of detail to which the alternative alignments were defined would have an important bearing on which criteria would be employed in various stages of the evaluation process. The feasible alignments have now been identified with the following general characteristics:

- alignments at a scale of one inch to 2000 feet;
- right-of-way (above and below mountain) predominantly above grade;

- alignments predominantly along existing road rights-of-way;

- general station locations.

For the purposes of feasible alignment generation, precise rights-of-way boundaries have not been established nor have precise station locations been determined.

The level of detail employed in the generation of feasible alignments has the following implications with respect to the selection of the shortlisting criteria:

a) criteria, which pertain to alignment distance through particular types of land uses can be employed but criteria which necessitate areal measurements, cannot be used;

b) criteria, which involve exact counts of displaced uses along the alignments, (except in the case of the tunnel alignments) would not be applicable at this stage;

c) criteria, which concern integration with other forms of transit and roadway disruption, would be broadly applicable, but criteria which concern impacts resulting from exact station locations would not be applicable at this stage;

d) criteria, which concern barriers to physical movement would generally not be applicable at this stage, although, in some instances, it will be possible to identify street closings;

e) criteria, which address impacts varying depending on column placement and the physical appearance of the guideway, would not be applicable at this stage;

f) general criteria concerning proximity to stations would be applicable, but criteria which would vary depending on station design would not be applicable at this stage;

g) cost criteria would have to be limited to general estimates based on unit costs and "surrogates" (substitutes) for costs e.g. number of stations, length of alignments;

h) transit ridership projections would not be possible although surrogates, such as population within distance x of alignment could be employed;

i) criteria, which would vary depending on construction and operations procedures, would not be applicable at this stage.

2.3 Other Considerations in Criteria Identification

2.3.1 Criteria Not Applicable

The level of detail employed in the identification of feasible alignments resulted in the elimination of a great many possible criteria. In reviewing the list of possible criteria, it also became evident that many criteria could not be linked to any characteristics of the study area. Furthermore,

some of the criteria addressed considerations which had already been addressed in the process of identifying feasible alignments or addressed considerations which did not vary by alignment.

2.3.2 Leverage Indicators

The large number of alignment alternatives has meant that to keep the evaluation process manageable, the number of criteria had to be minimized, consistent with the requirement of ensuring that the shortlisted alignments are clearly preferable to those alignments which are rejected. Towards that end, an attempt has been made to identify "leverage" criteria; that is, criteria which reflect fundamental differences among alternatives and which serve as general measures of a variety of positive and negative impacts. Distance abutting residential areas, for example, serves as a general measure of relative differences in visual intrusion and community disruption. Similarly, the number of major activity centres (as ranked in Task A2) within distance x of stations provides a good general indicator of transit service in both the peak and off-peak periods and in terms of both projected use and potential uses resulting from development or redevelopment.

2.3.3 Available Information

In order to minimize unnecessary information gathering in the initial stages, emphasis has been given to criteria which can be employed using readily available information.

2.4 Methods of Reducing Complexity

Even with the procedures noted above, the large number of alternative alignments has made it extremely difficult to readily identify which of the feasible alignments should be shortlisted. A variety of methods will, therefore, be employed to reduce the complexity of the analysis and to facilitate the shortlisting process.

2.4.1 Criteria Elimination - Negligible Differences

Once the analysis has been undertaken of the feasible alignments, it is probable that the differences among the alignments, for some criteria, will be negligible. In such cases, providing "negligible difference" is carefully defined, some criteria can be eliminated from the comparative analysis.

2.4.2 Criteria - Elimination - Insignificant Impacts

For some impact criteria, the impacts may be of such a minor nature that they would not represent a consideration in the comparative analysis. The decision, as to what is an insignificant impact, is basically a matter of judgement. Criteria will, therefore, only be eliminated, on the basis of insignificance, in extremely obvious cases where it would be impossible to argue that the impacts merit further consideration.

2.4.3 Grouping Criteria

Although the number of criteria may be fairly sizable, criteria can often be combined into broad groupings. There may, for example, be several criteria which measure different aspects of transit service, social and environmental impact and public costs. When individual criteria can be grouped, in a manner which results in overall conclusions with respect to such groupings, it should be much easier to identify fundamental differences among alignments.

2.4.4 Grouping Alignments

In some instances (especially in the downtown area), rather than twelve distinct alignments, what has occurred are series of alignment variations which could be grouped for different geographic areas. Alternatively, alignments might be grouped on the basis of such other shared characteristics as orientation, (north-south or east-west), number of stations, direction of access to the downtown and major or secondary streets. In such cases, it may be desirable to treat these variations as subsets. These variations or options could be compared separately with the least desirable options being eliminated. The selected option or options would then be incorporated back into the broader comparative evaluation.

2.4.5 Ranking Criteria

The relative importance attached to different criteria will naturally vary depending on the area and the interest groups involved. Once the criteria are selected, it is important to obtain a reading from the major parties in the process concerning which criteria they consider to be most significant and why. To the extent that particular criteria emerge as consistently more "important" in the minds of the major interests in the process, it will be possible to give particular consideration to differences among alternatives in terms of the most important criteria.

2.4.6 Staged Evaluation

It is highly unlikely that it will be possible to move directly from the feasible alternatives to four alternatives in a single step for all the subareas; particularly in the downtown area.

The shortlisting evaluation process has, therefore, been divided into two major stages. The first stage would involve comparisions between alternative alignments where there is essentially no tradeoff; that is, situations where one alignment is substantially less desirable than another alignment, for one or more criteria groupings and no more desirable than the other alignment for the remaining criteria groupings. Such a relationship is often referred to as one of "dominance", with one alternative dominating the other in a systematic comparison.

If the criteria are grouped under four major headings, for example, service, transit integration, cost and impacts, five types of dominance relationships might occur.

a) Costs substantially higher than the costs of at least 4 other alignments with no offsetting benefits in terms of service (projected and potential as a result of development and redevelopment), surface transit integration, cost and impact (land use, social, natural, roads and public services).

b) Substantially lower level of service than at least 4 other alignments with no offsetting benefits in terms of cost, transit integration and impacts.

c) Substantially poorer integration with other forms of transit than at least 4 other alignments with no offsetting benefits in terms of level of service, cost and impacts.

d) Substantially greater adverse impacts than at least 4 other alignments with no offsetting benefits in terms of level of service, cost and transit integration.

e) A combination of results, with respect to more than one criterion in which an alignment is dominated by at least four other alignments.

The second evaluation stage would occur where tradeoffs are involved; that is where one alternative is superior to another in terms of one or more criteria groupings but inferior with respect to one or more other criteria groupings. The focus in this stage would, therefore, be on "obvious"

tradeoffs; situations where an alternative is substantially less desirable than four other alignments for one or more criteria groupings and only slightly superior with respect to the remaining criteria grouping(s). The process could be repeated for the five types of situations described in stage one. As there is again an element of judgement in this stage, terms such as "substantially greater than" and "slightly better than" will have to be carefully defined, considering both the magnitude of differences and the relative significance attached to different criteria.

If the evaluation process has proceeded through both these stages and more than four alignments still remain, it may be necessary to add additional criteria to bring out further differences; but still aimed towards situations where the tradeoffs are obvious. It is anticipated that, by employing the approach described above, the alignments which remain at the four way comparative evaluation stage, will be limited to those where the differences are relatively subtle or where the tradeoffs are more fundamental e.g. Alternative A better than Alternative B with respect to cost and transit integration and Alternative B better than Alternative A in terms of impacts and transit service.

2.4.7 Paired Evaluation

Comparing twelve alignments at one time is an extremely difficult task. An alternative approach is to successively compare two alignments at a time, on a criterion by criterion basis. Alternative A, for example, would be compared with Alternative B, then Alternative C, then Alternative D and so

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on for all the groupings of criteria. Through this procedure, it will be possible to identify relative positions and progressively eliminate undesirable alignment alternatives.

2.4.8 Analysis of Difference

Many of the alternative alignments share common segments. The use of a paired evaluation technique has the additional advantage that one alignment can be placed as an overlay over another alignment. The comparative analysis would then only focus on those portions of alignment segments which are different.

2.4.9 Scaling

The process of progressively eliminating inferior alternatives is very much dependant on how terms such as substantially greater than or substantially less than are defined. The use of scaling techniques can assist in defining such terms more precisely and in ensuring that they are not employed in an arbitrary manner.

3.0 EVALUATION METHODS - SUBAREAS

3.1 Introduction

The large number of feasible alternatives, options and criteria necessitates a systematic approach to evaluation. After considerable discussion and review an approach was jointly developed which divided the alignments in a series of segments which could be progressively combined into shortlisted alignments. This approach will simplify the comparative analysis in terms of both technical analysis and political and public review.

This procedure is described below. Although it is presented in a sequential fashion the process is, in fact, highly iterative. Thus, as each segment is analyzed continuous checks will be made to ensure that the analysis is consistent with and complementary to the preceding analysis and to the analysis being undertaken simultaneously. In this way the analyses of different segments will be consistent and the segments themselves can be coherently combined into overall transit systems.

3.2 Mountain Subarea - Segments A and B

The mountain subarea contains three basic alignments. Associated with two of these alignments are pairs of optional alignment segments. There are two alignment segment options for Segment A, in moving from the node at Upper Wentworth Street and Mohawk Road to the mountain terminal point. (Figure 1).

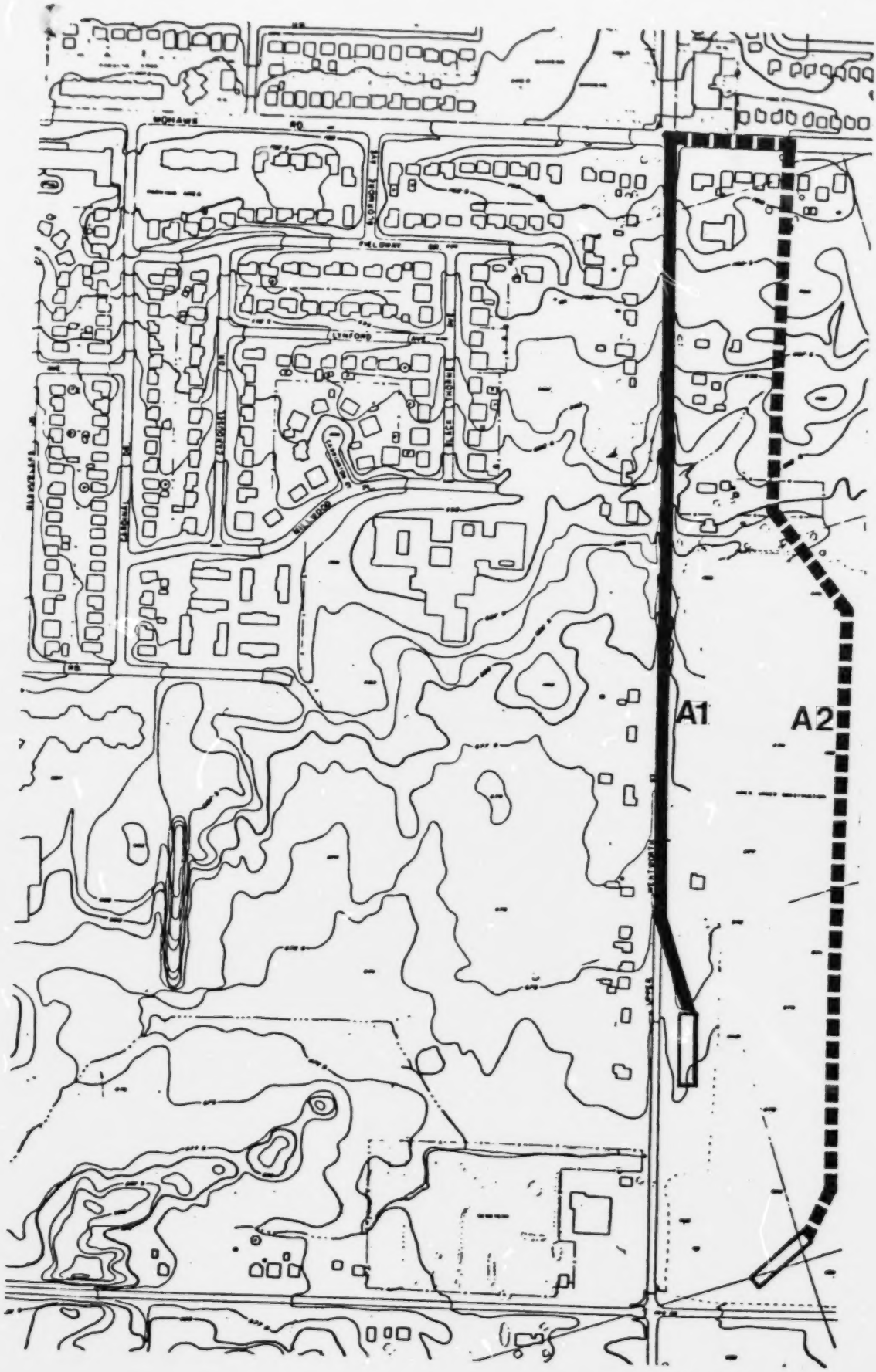

FIGURE 1 - A SEGMENTS

There are also two alignment segment options associated with Segment B in moving from Segment A to the node at Upper Wellington Street and Mohawk Road (Figure 2). The definition of Segment B is dependent on the completion of the Segment A analysis and evaluation. Hence, the Section A analysis should be undertaken before the Segment B analysis.

The Upper Wellington Street alignment also includes one pair of station location options. The two general station location options are Fennell Avenue East and Queensdale Avenue East. The selection of the preferred station location should occur before the analysis of Segment C.

3.3 Escarpment Subarea - Connections to Downtown - Segments D and E

Segments D and E represent alignment options for crossing the escarpment. Segment D consists of a total of five alignment options for linking the Upper Wellington Street and Mohawk Road node to the base of the escarpment. D1A and D1B are tunnel alignments, D2A and D2B are elevated alignments and D2C is an open cut alignment (Figures 3 and 4). Segment E consists of three alignment options for linking Upper James Street and James Street South. E1A and E1B are tunnel alignments and E2 is an elevated system (Figure 5). The analysis and evaluation of Segment D is especially important as the analysis of Segments H and J is dependent on a decision concerning the Segment D alignment options.

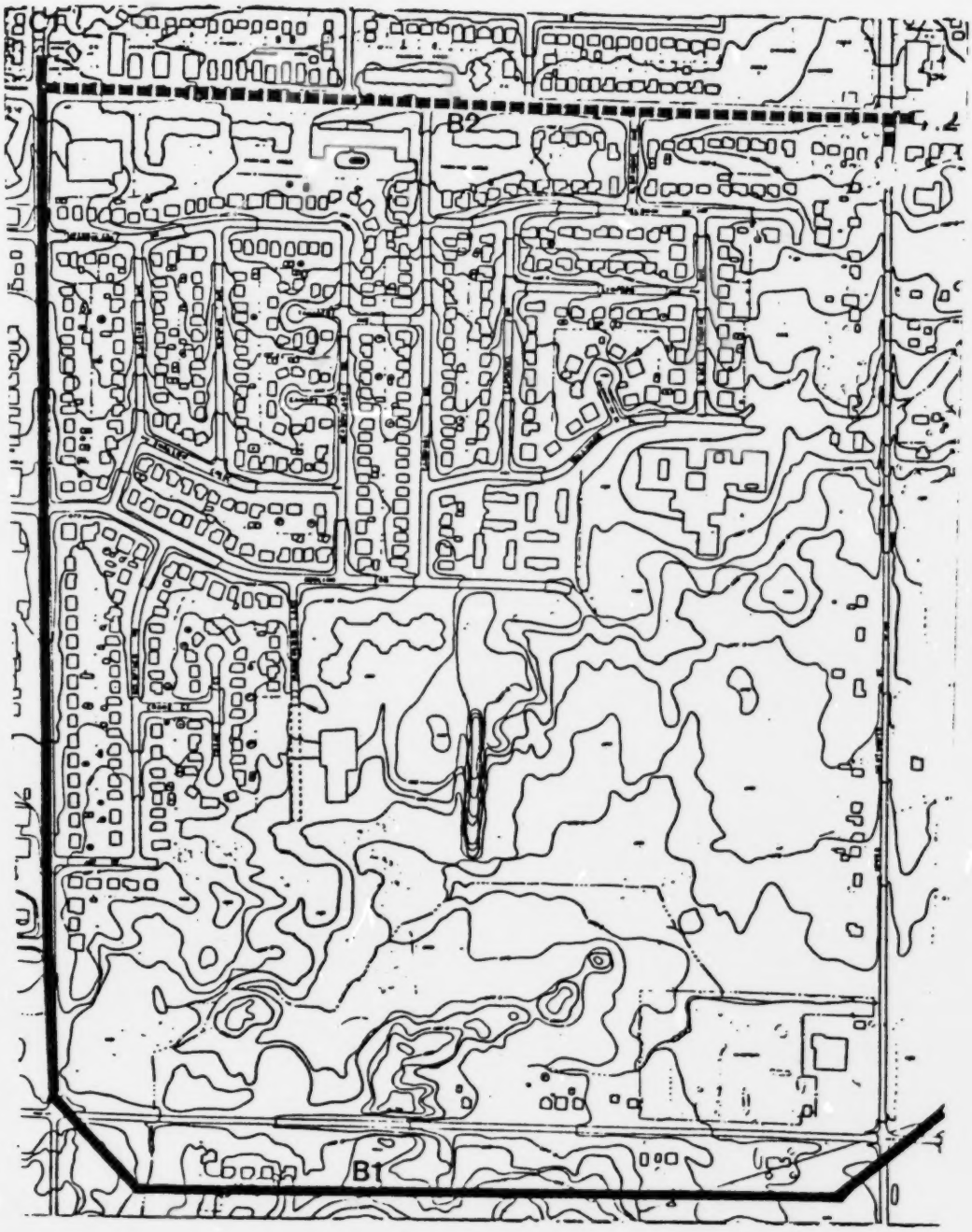

FIGURE 2 - B SEGMENTS

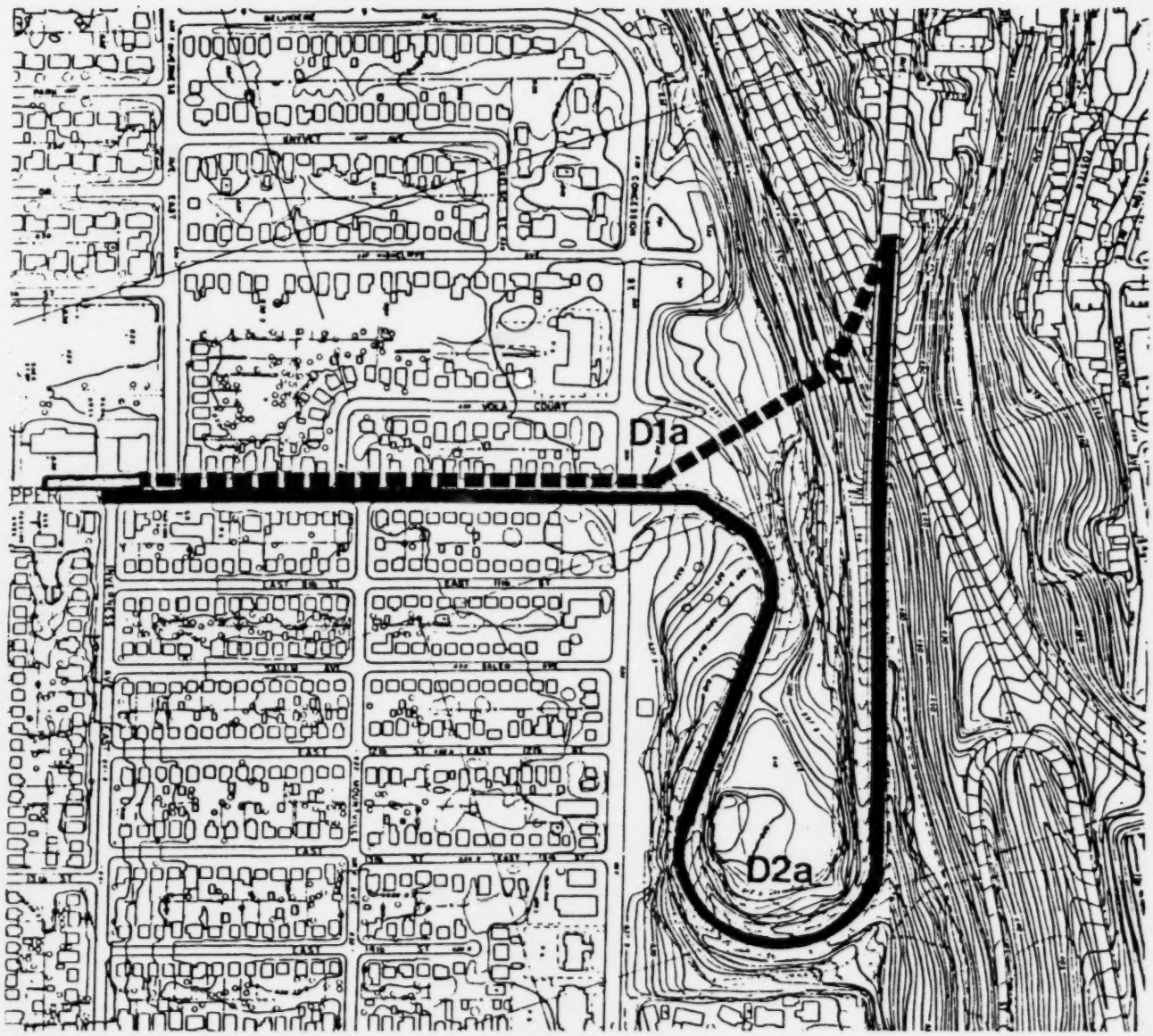

FIGURE 3 - D SEGMENTS
(D1A and D2A)

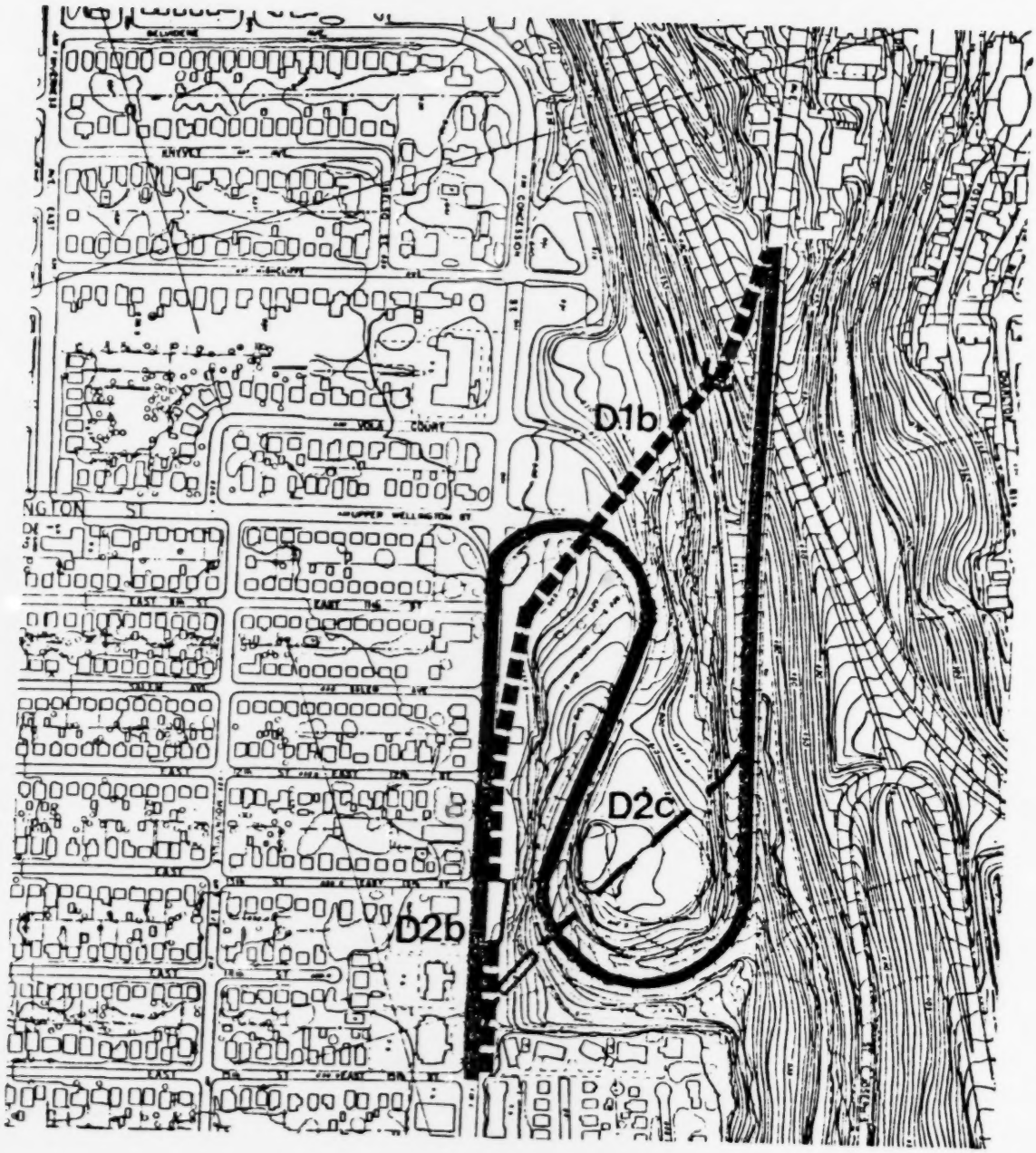

FIGURE 4 - D SEGMENTS
(D1B, D2B, D2C)

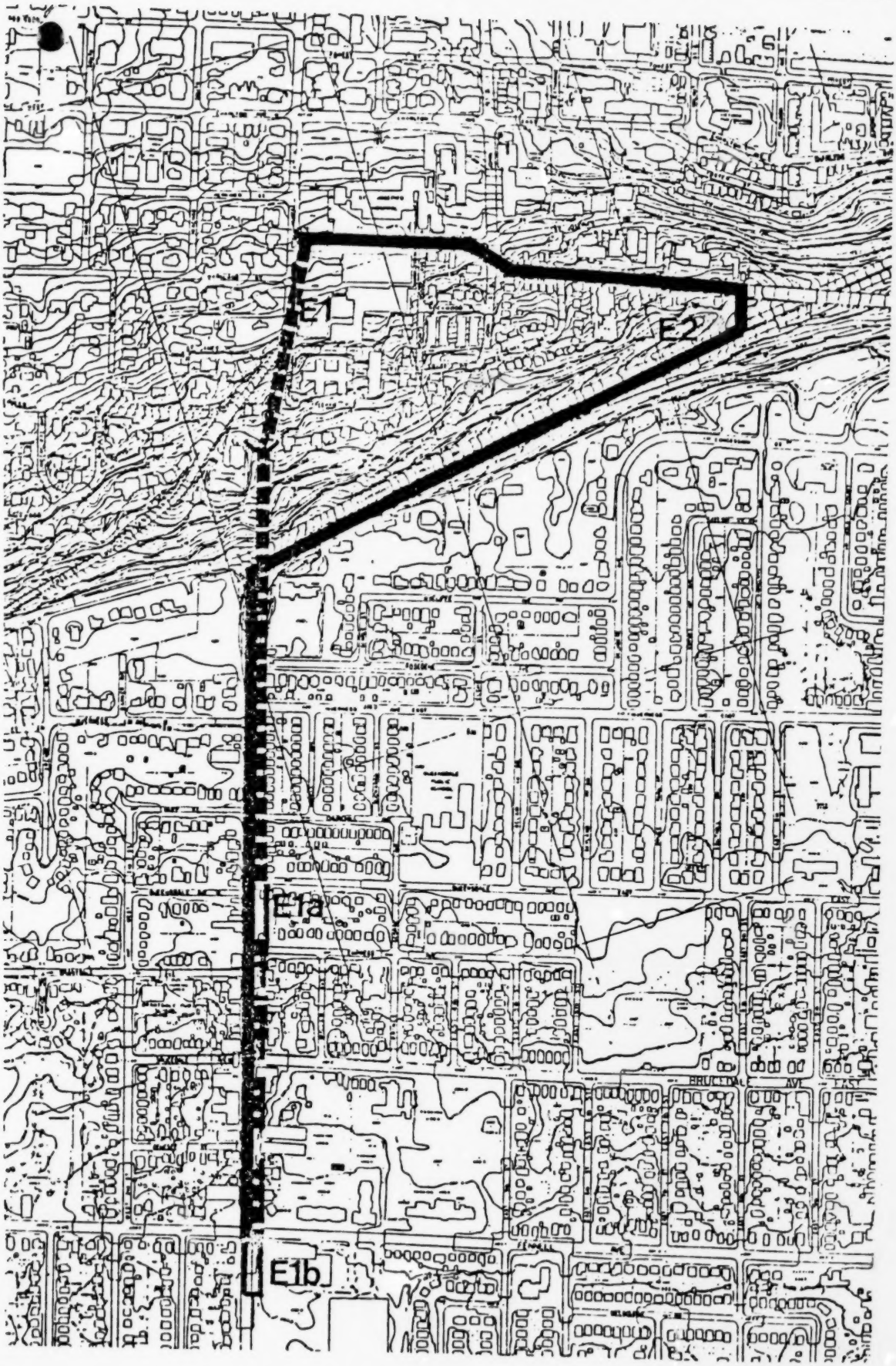

FIGURE 5 - E SEGMENTS

3.4 Escarpment Subarea - Connections to Downtown - Segments I and J

A number of possible north-south streets could be used to move from the base of the escarpment to the King/Main corridor. Segment I encompasses an analysis of three of those streets - Ferguson Avenue, Walnut Street and a direct connection from the railway to Mary Street (Figure 6). The analysis of the Segment F alignment options is conditional upon the identification of a preferred north-south connection to the King/Main corridor (CBD 1).

Segment J includes three alignment options for connecting the escarpment tunnel portal (from the Segment D analysis) to the John/Catherine corridor (Figure 7).

3.5 Escarpment Subarea - Connections to Downtown - Segment F

Once the Segment I analysis has been completed, there will remain two pairs of alignment options. Options F1A and F2A serve Wellington Street and F1B and F2B serve Concession Street. North of the escarpment, F1 connects to a Ferguson Street alignment and F2 follows the Claremont (Figure 8). These two options will be addressed in the Segment F analysis and evaluation.

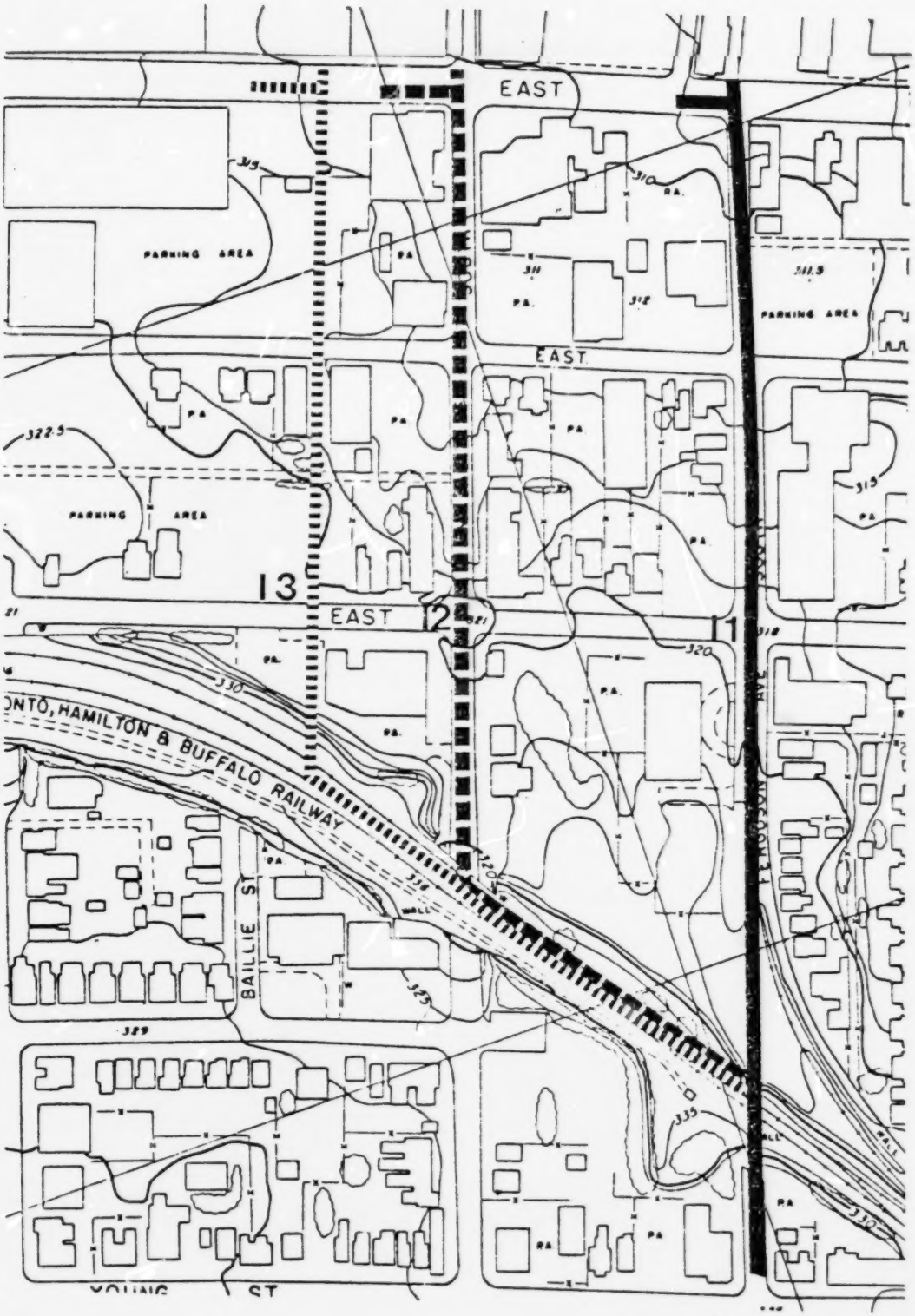

FIGURE 6 - I SEGMENTS

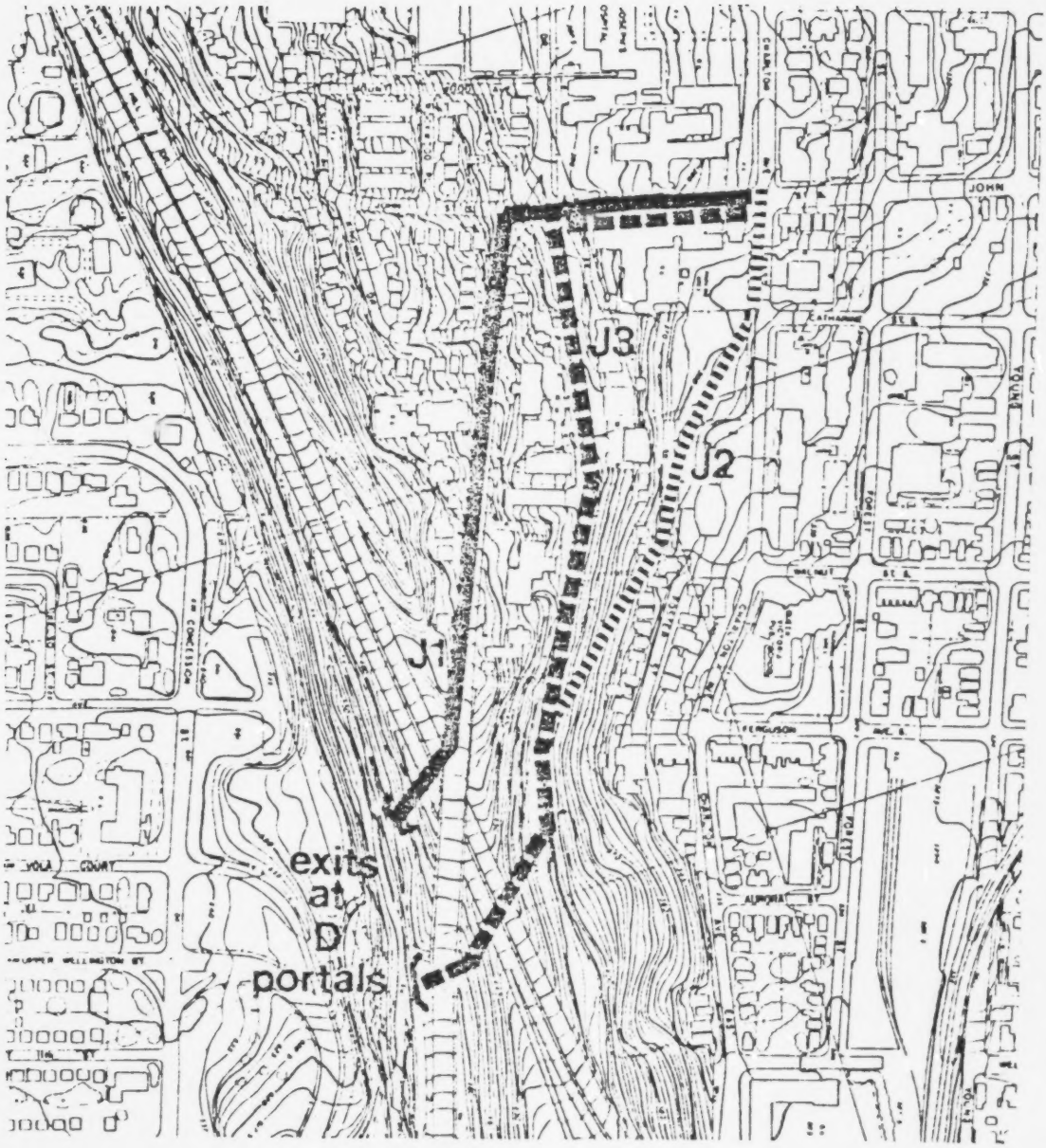

FIGURE 7 - J SEGMENTS

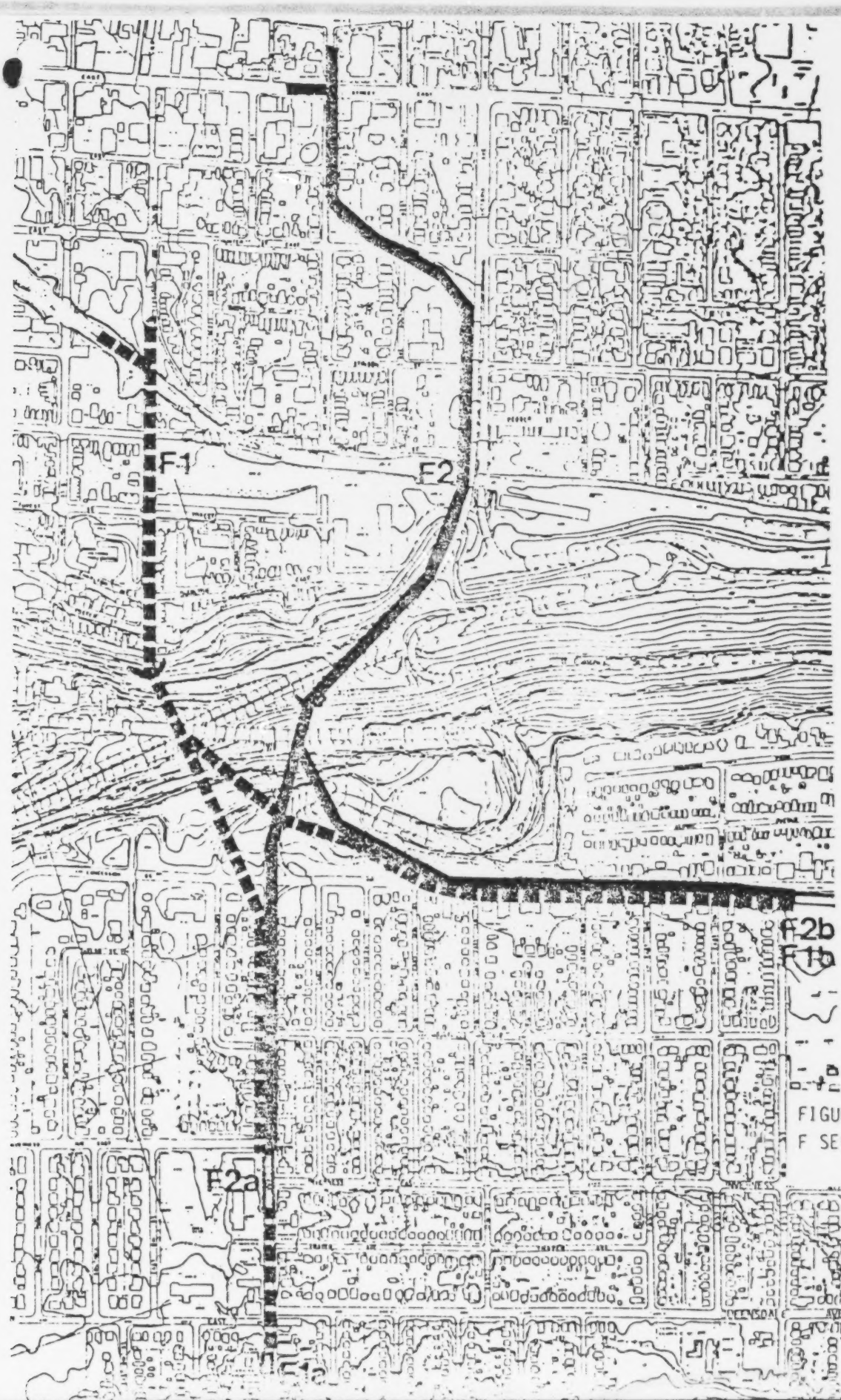

FIGURE 8 - F SEGMENTS

3.6 Escarpment Subarea - Connections to Downtown - Segment H

Recognizing that the use of an existing major transportation corridor, such as a railway right-of-way, would eliminate a number of integration/impact problems, the use of the entire TH and B right-of-way from the Claremont Hill Access Road to MacNab Street will be added to the analysis (Figure 9).

3.7 Downtown Subarea - Secondary Station Location and Alignment Options

There are two pairs of minor alignment options in the downtown area which should be addressed before a more detailed analysis of alternative downtown circulation options can be undertaken.

The first pair of options concern the connection between Hunter/Catherine and James/King. The choices involve either proceeding west along Hunter and north across MacNab or north along Catherine and west across King.

The second pair of options concern the connection between James/Main and MacNab/King. The choices involve either proceeding west along Main and north across MacNab or north along James and west across King.

In addition there is one pair of station location options. The two general station location options are in the vicinities of King/Main - MacNab or King/Main - Hughson.

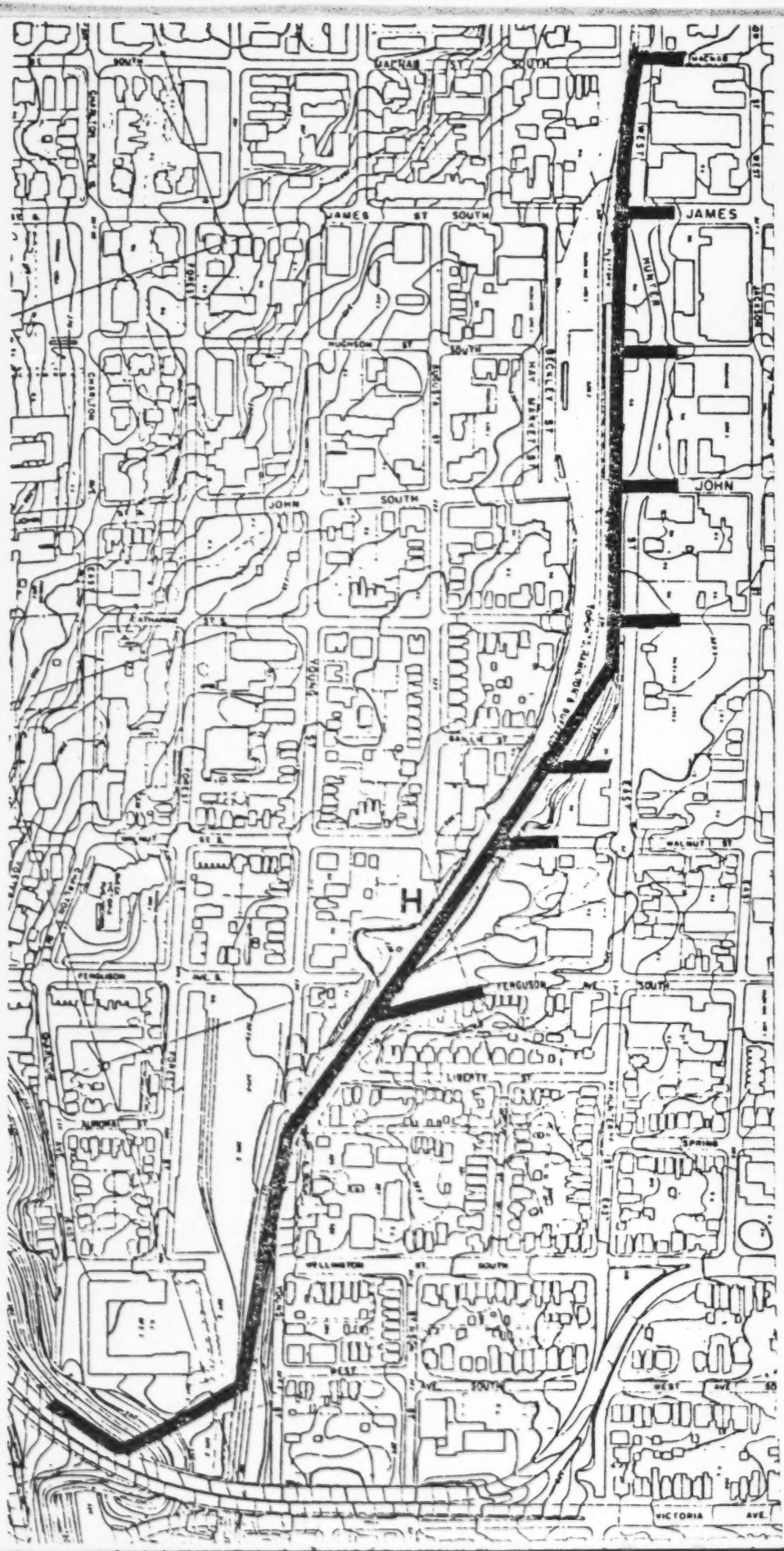

FIGURE 9 - H SEGMENTS

3.8 Downtown Orientations - CBD 1, 2 and 3

One distinguishing feature of the downtown subarea alignment alternatives is the direction of access to the downtown. The direction of access not only influences the relative directness of connections to different portions of the downtown, but it also largely determines whether the predominant orientation of the alignments are east-west or north-south.

These three approaches have been identified as CBD 1, CBD 2 and CBD 3. One method of simplifying the comparison of alignment alternatives might be to compare the major distinguishing features of these three groups.

3.9 Downtown Subarea - Alignment Pairs

The three downtown orientations, CBD 1, 2 and 3, each contain two roads which might serve as alignments; King/Main in the case of CBD 1 (with an option of King William Street east of Catherine Street) (Figure 10), John/Catherine in the case of CBD 2 (Figure 11), and James/Hughson with CBD 3 (Figure 11). The major transportation, planning, design and engineering constraints associated with these pairs of potential alignments should be analyzed and evaluated. If there are overwhelming problems associated with either of the alignments they can be eliminated from further consideration.

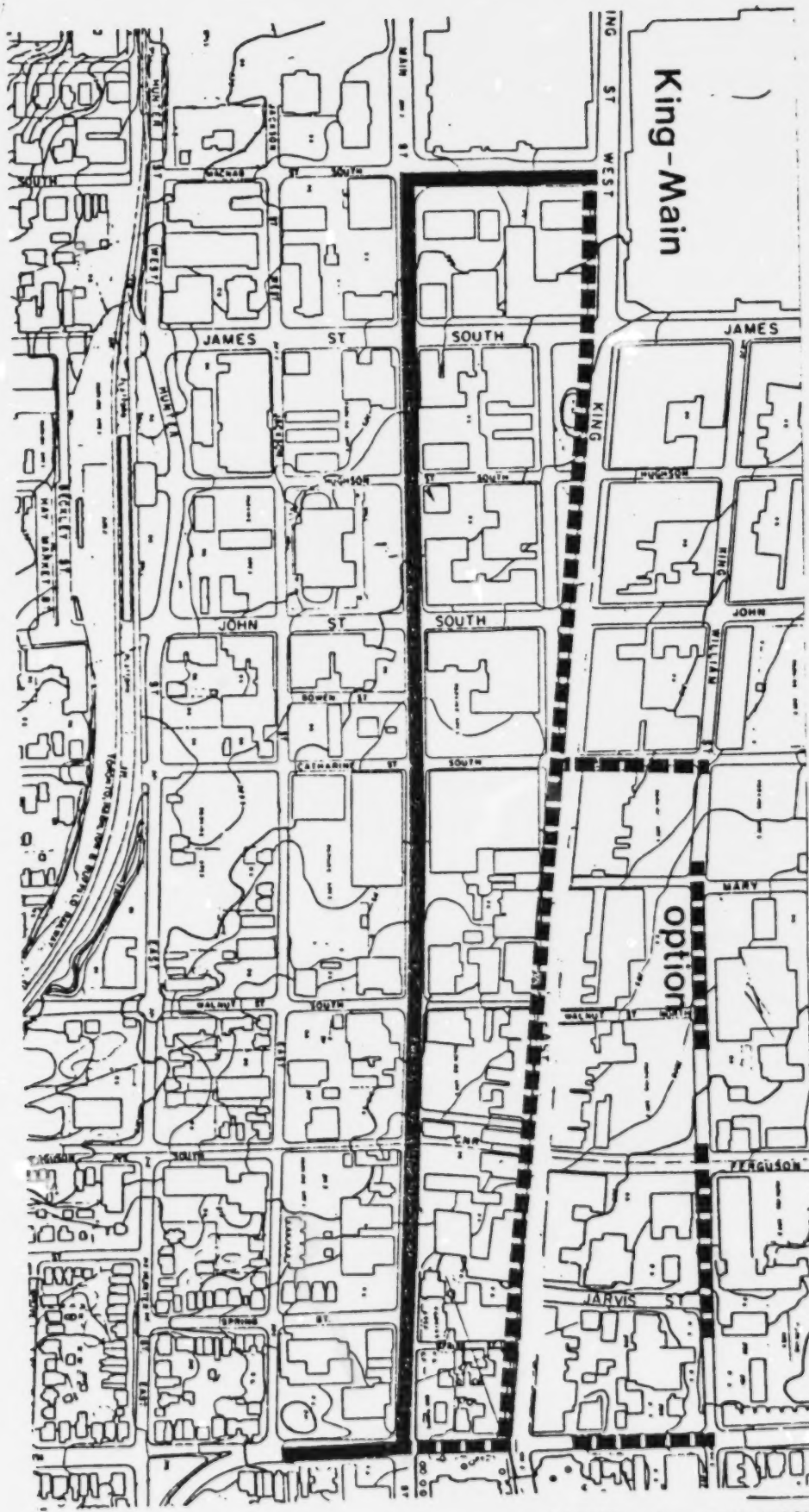

FIGURE 10 - KING/MAIN/KING WILLIAM

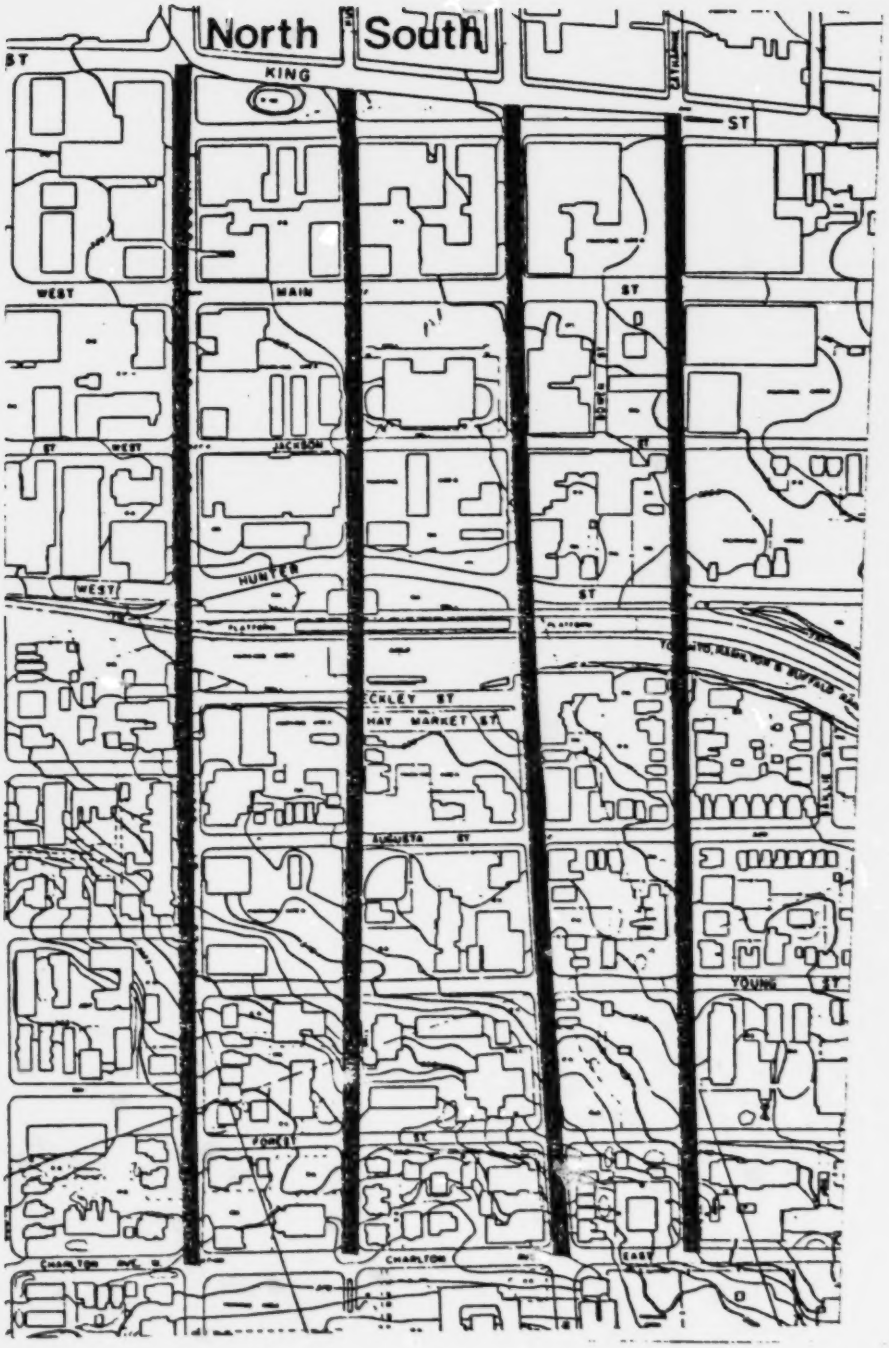

FIGURE 11 - CATHERINE/JOHN/
HUGHSON/JAMES

3.10 Downtown Subarea - Number of Stations

Several of downtown alignment alternatives are quite flexible with respect to the number of stations which can be placed on the alignment. The varying number of stations (and the potential for additional stations) makes comparison very difficult. In such instances an analysis should be undertaken of each alignment with different numbers of stations.

Presumably the primary tradeoff would be as follows: additional stations means greater costs, impacts and trip time but also enhanced accessibility to the downtown. The critical question in the analysis would, therefore, be how much greater is the convenience provided by the additional stations and is it worth the additional cost, trip time and impacts?

It may become clear fairly readily, for example, that the improvement in convenience provided by 4 or 5 stations may be only marginal without extensive new development or redevelopment and the costs, impacts, and increased trip time vary substantially. If such is the case, the alignment would be modified by dropping one or two stations.

3.11 Downtown Loop

Several of the downtown alignments involve systems of loops. An initial analysis of one of the more prominant loops - an outer loop (Catherine; Jackson; MacNab; King William) could be undertaken. As illustrated in Figure 12, this analysis could include an optional southern limit to the TH and B.

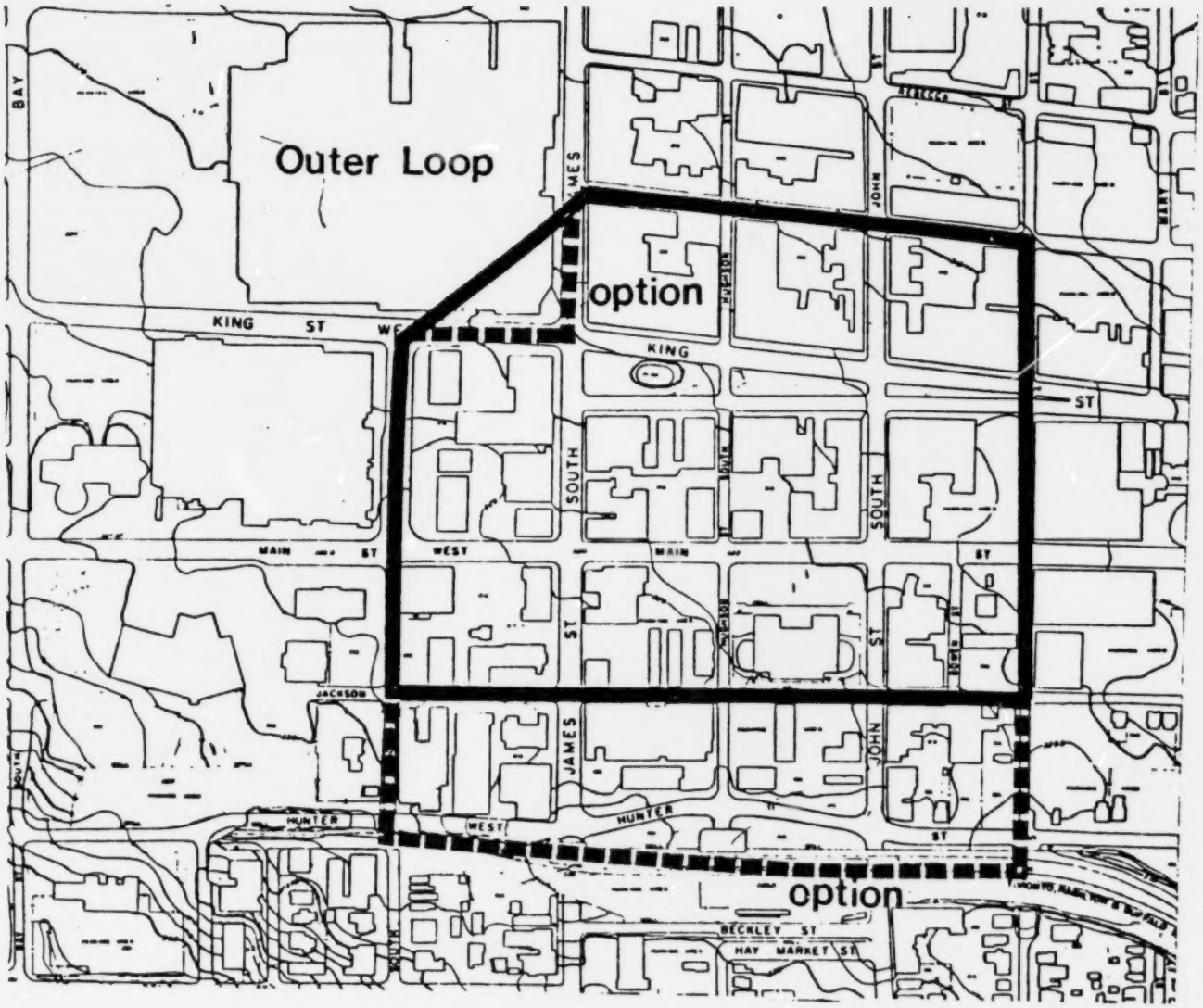

FIGURE 12 - OUTER LOOP

3.12 Definition of Downtown Alignment Options

The analysis to this point will have greatly simplified the complex maze of downtown alignment and station options. It should, therefore, be possible to generate, fairly readily, a small number of downtown circulation system options (e.g. 6). The generation of such options is essential at this juncture to ensure that the various selected segments in the downtown can be combined into a functional transit system. One or more of these options would include provision for a loop at the west end of the downtown.

3.13 Transit System Analysis

Before proceeding to the systematic analysis and evaluation of the downtown alignment options it would also be desirable if particular attention is devoted to how the downtown alignment options are combined with the selected segments to the south to ensure that the combinations of segments among the three subareas represent functional rapid transit systems. It would be at this point that such overall transit systems criteria as travel time between terminal points, route length, number of stations, overall unit cost, and proximity to potential maintenance facilities would be introduced. Any downtown subarea alternatives which, when combined with the remaining mountain and escarpment alignment segments, provided clearly inferior rapid transit service, would be eliminated from further consideration.

3.14 Analysis of Downtown Alignment Options

The analysis undertaken to this juncture will have meant that the remaining alignments in the downtown subarea will have been:

- refined in terms of options within alignments;
- consistent with and complementary to the analysis undertaken in the mountain and escarpment subareas;
- screened with respect to number of stations;
- screened with respect to directions of approach to the downtown;
- screened with respect to pairs of alignments;
- tested in terms of overriding problems associated with particular alignment segments;
- tested in a transit systems sense.

As a result the remaining alternative alignments should be relatively small in number (5 to 7). The scope of the alignment alternatives will also have been reduced to largely that of alternative downtown circulation systems, with similar numbers of stations and similar east-west or north-south orientations.

The task of comparing alternative alignments should, therefore, not be unduly complex at this point and can proceed in a manner comparable to that employed in the other subareas, i.e. the progressive elimination of the least acceptable alignments.

3.15 Mountain Subarea - Segment C

The final segment analysis which may be undertaken at this stage concerns connecting the Upper Wentworth and Fennell mode to the Upper Wellington Street and Concession Street node. Two alignment alternatives have been identified - one which follows an Upper Wentworth/Concession routing and the other which proceeds down Upper Wellington (Figure 13). The Segment C analysis cannot proceed until the Segment A and B analysis has been completed.

At this point it is not certain whether the Segment C analysis will be undertaken at this evaluation stage or whether it will be deferred to the next stage - the comparative analysis of the shortlisted alternatives.

3.16 Segments K and L

Although it would not be necessary to compare it to any other alignment, the subsequent comparison of shortlisted alignments would be facilitated by an overview of the Upper James Street-Mohawk Road corridor (Figure 14).

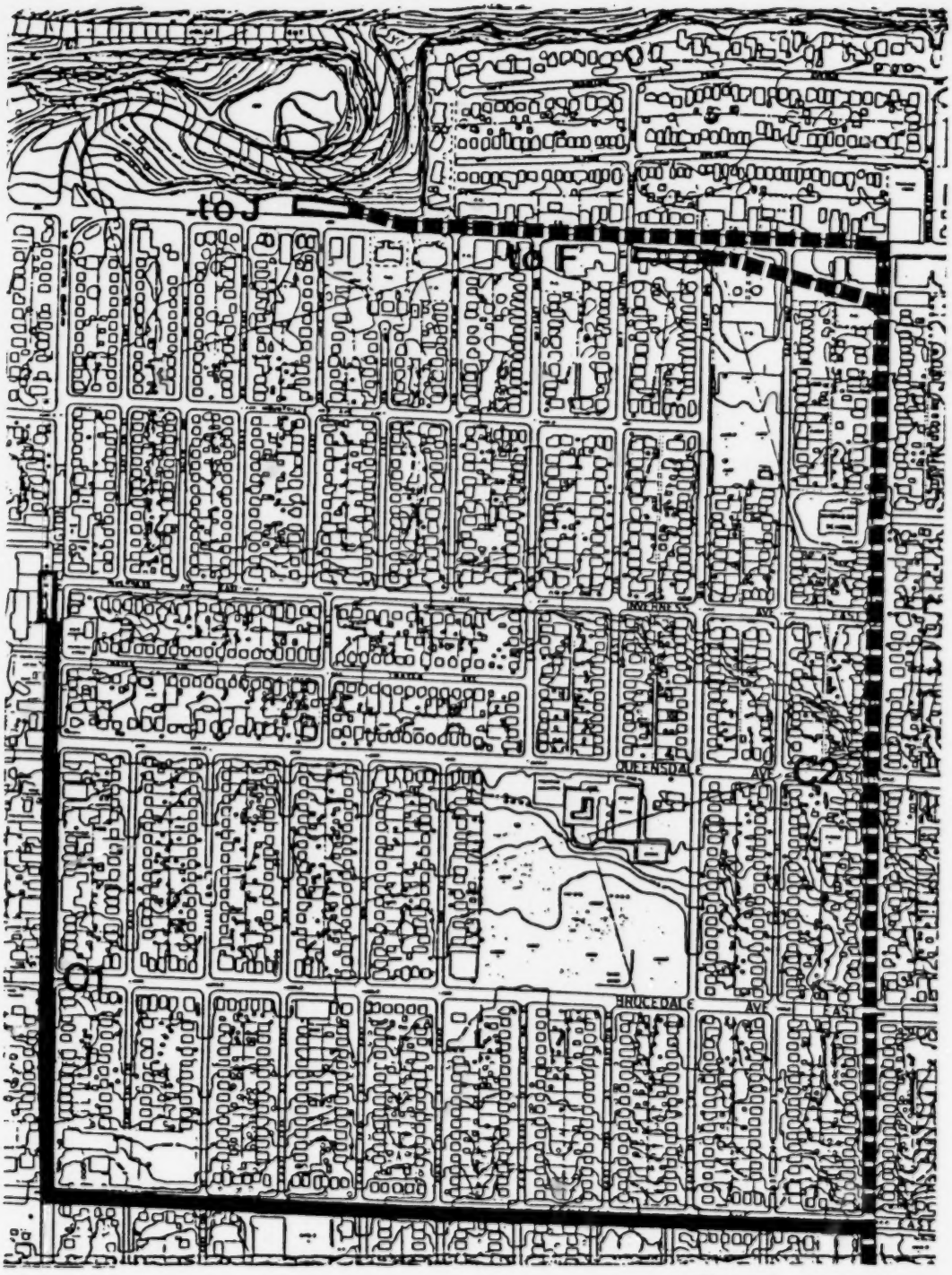

FIGURE 13 - C SEGMENTS

As a result of Regional input, an alignment segment was reintroduced involving a connection from Upper Wentworth across Fennell Avenue to offer an alternative to an Upper Wellington Street alignment (Figure 15).

3.17 Analysis and Review Procedures

3.17.1 Analysis of Alternatives

The analysis of alternatives will be undertaken jointly by the planning, engineering and environmental teams. It will be the task of the evaluation team to assist in the compilation of the analysis of alternatives employing the information generated by the other teams.

In view of the limited time available for the analysis of the feasible alternatives, the analysis will proceed simultaneously in a number of areas.

The general sequence of analysis would be the mountain subarea, the escarpment subarea and the downtown subarea. This sequence will, however, be modified depending on such considerations as availability of information and relative interdependence among segments.

The product of this analysis should, in all cases, be recorded on evaluation tables and supported by additional materials elaborating on the results of the analysis and the methods employed.

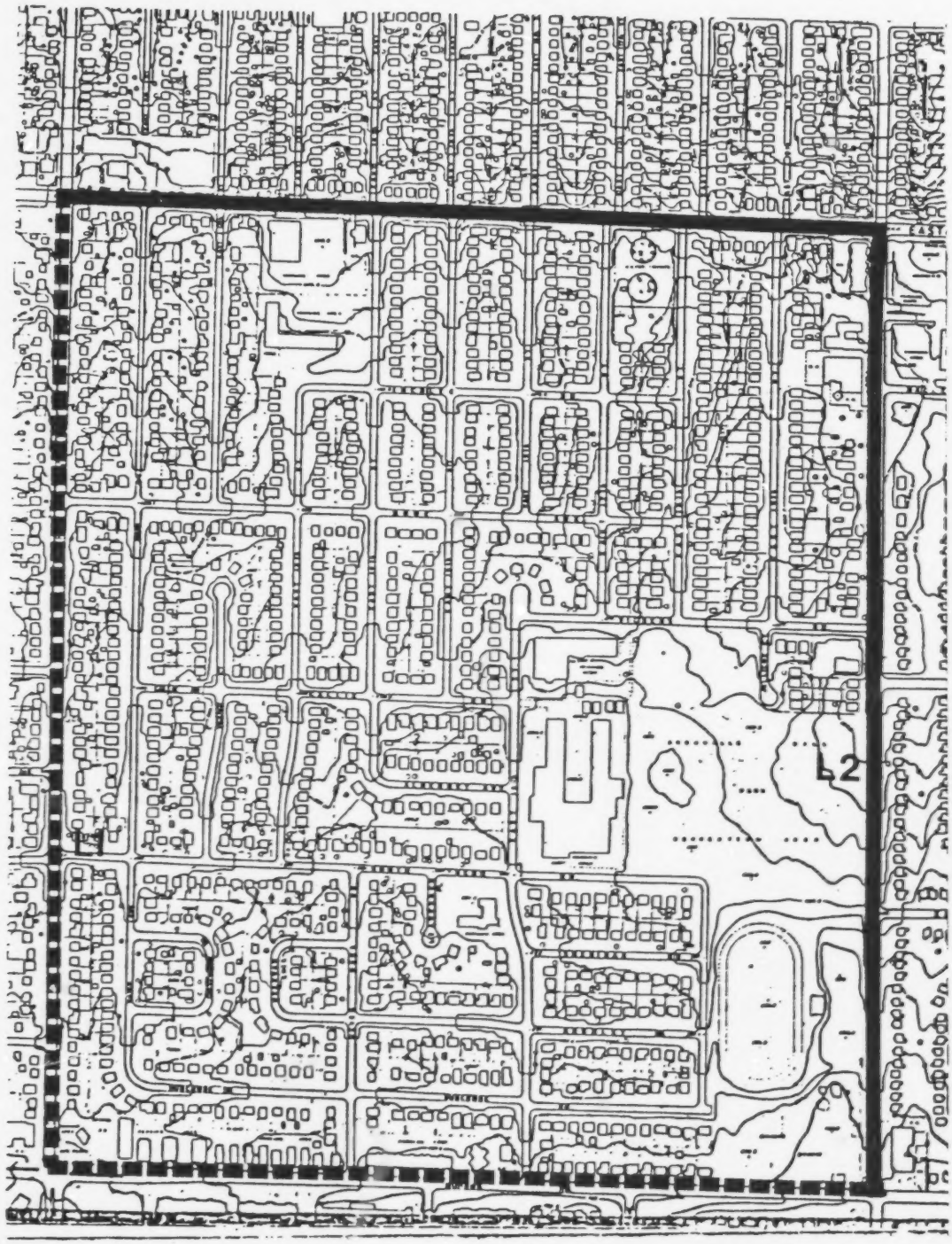

FIGURE 15 - L SEGMENTS

3.17.2 Interaction - Analysis, Compilation, Evaluation, and Review

The process of analysis, compilation, evaluation and review described in this document is that of a series of steps directed towards progressively eliminating less desirable options and alignment alternatives. Consistent with this process, rather than envisioning the activities as distinct and sequential stages, a more appropriate approach would be an iterative process with each cycle in this process corresponding with the major decision points involved in moving from 12 or more feasible alignments to a shortlisting of four alignments.

Each cycle in this process would consist of four parts:

- the technical analysis undertaken by the planning, engineering and environmental teams;
- the compilation of the analysis by UTDC with the assistance of the evaluation team;
- the evaluation of the compiled analysis by UTDC;
- the technical review of each step by the Region.

For this procedure to operate efficiently, rather than preparing a single analysis document and a single compilation document, it would be more desirable if the results of the analysis and the compilation are circulated in a series of working documents, corresponding with the successive decision points. In this way the danger of a decision reached near the beginning of the process being reversed during review

(necessitating the revision of all subsequent work) would be minimized.

The major points in the process of moving from feasible alignments to the four shortlisting alignments are as follows:

1. Mountain Subarea
   - Segment A
   - Segment B
   - Upper Wellington station location options

2. Escarpment Subarea
   - Segment D
   - Segment E

3. Escarpment Subarea
   - Segment I
   - Segment J

4. Escarpment Subarea
   - Segment F
   - Segment H

5. Downtown Subarea
   - Secondary Station and Alignment Options
   - Downtown Orientation - CBD 1, 2 and 3
   - Alignment Pairs
   - Number of Stations
   - Downtown Loop
   - Definition of Downtown Alignment Options

6. Transit Systems Analysis.

7. Downtown Subarea
   - analysis of options

8. Mountain Subarea
   - Segment C
   - Segment K
   - Segment L

The first four steps and steps 6 through 8 in the procedure described above are relatively discrete although interdependent. However, step 5 involves so many secondary decision points that the process should be characterized by almost daily discussions among the major study participants.

3.17.3 Political and Public Input

Public information centres will be held through the analysis and evaluation process. The information centres will assist in both establishing the relative importance attached to different evaluation criteria and in obtaining public reaction to the feasible alignment segments.

The shortlisting will also be subject to political and public review. In view of the complexity of the feasible alignments and the consequent complexity in evaluation methods, it is suggested that particular attention be devoted to methods of displaying the alignments and evaluation methods in forms which will facilitate comprehension and political and public participation.

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4.0 CRITERIA FOR SHORTLISTING

The procedure for selecting appropriate criteria for the shortlisting comparative analysis took place in three major steps involving UTDC and all the consultant teams. The first step was the elimination of criteria not suitable for the analysis at this stage in the evaluation process. The major factors which resulted in the elimination of criteria from consideration in this stage of the project were; not applicable, fully addressed in the generation of feasible alignments, no differences among alignments, suitable for more detailed analysis in subsequent stages of the project and adequately addressed by other criteria.

The second stage in the process of criteria selection was the identification and modification of criteria from the Evaluation Framework and Preliminary Criteria Report which were suitable for different subareas.

The third stage in the process was the organization of the selected criteria into formats suitable for evaluation tables.

4.1 Criteria Elimination

4.1.1 Not Applicable

The following criteria were eliminated because they did not apply to the study area or to the design characteristics of the feasible alignments:

Objective	Criteria	Comments
. access to and among activity centres (3e and 3h)	. door to door travel time among activity centres	. no major interactions among activity centres
. integration with inter-regional service (4a)	. proximity to planned multi-modal transportation terminal	. location of multi-modal terminal not yet determined
. proximity to public parking facilities (4f)	. number of existing, committed and planned parking places within distance x	. no public parking near mountain transfer points
. environmentally sensitive features other than the escarpment (5b)	. distance through and abutting and acres displaced	. Niagara Escarpment only sensitive natural area in corridor
. noise, and vibration impacts (6b (i) and 6b (ii)	. number of dwellings and lots above standards and above ambient levels	. design of vehicles and structures such that noise and vibration levels will be below ambient
. access to community facilities, services and amenities (6c (ii))	. number of elementary schools, and other community facility catchment areas severed	. as system predominantly elevated and along existing rights-of-way not an issue; (except in escarpment subarea affected by tunnels)
	. number of primary access routes to community facilities and parks made more indirect or otherwise disrupted	. as above
	. changes in walking and driving time to neighbourhood facilities	. as above

Objective	Criteria	Comments
. severance of bicycle trails (6c (vi))	. number of trails severed or made more indirect	. no bicycle trails affected by alignments
. disruption of functionally related uses (6c (vii))	. number of functionally related uses where interactions seriously impacted	. no functionally related uses affected by alignments
. opportunities to separate incompatible uses (6c (viii))	. number of major incompatible uses separated	. no incompatible uses which would be separated
. value capture (7g)	. qualitative analysis	. outside scope of study
. flexibility to respond to changes in public transportation priorities and programs (8e)	. qualitative analysis - degree of dependence upon planned and proposed rather existing and committed transportation facilities	. no alignments dependent on planned or proposed transportation facilities

4.1.2 Previously Addressed

The following criteria concern matters which were already addressed in the identification of feasible alignments.

. public access to and along escarpment (5a (i))	. number of trails severed or rerouted	. feasible alignments designed not to interrupt Bruce Trail
. displacement of people, jobs and buildings (6a iv), (6a v), (6a vi)	. number of persons, dwelling units, public and private facilities displaced	. largely addressed by locating routes along existing road rights-of-way

Objective	Criteria	Comments
. severance of communities and neighbourhoods (6c ix)	. number of communities severed	. addressed by locating routes along existing road rights-of-way

4.1.3 No Difference

The following criteria apply to matters which would not vary among the alignments.

. integration with inter-regional transit services (4a)	. qualitative analysis - connections to regional surface transit system	. all alignments have same terminal point above mountain
. air pollution (6b i)	. air pollution levels	. positive factor addressed in intermodal comparison and design; would not vary with alignment
. opportunities to reinforce community boundaries (6c x)	. number of communities for which boundaries are reinforced	. elevated system and alignments along existing road rights-of-way should mean negligible differences

4.1.4 Subsequent Analysis

The following criteria concern matters which will be addressed in subsequent stages of the study.

Objective/Criteria	Stage	Comments
. peak travel demand ridership measures (3a)	. four-way comparison	. ridership information not available; addressed indirectly
. social and economic groups heavily dependent on transit - number of households and units (3c)	. four-way comparison	. requires detailed analysis
. potential to serve elderly and handicapped - number of units (3j)	. four-way comparison, preliminary design and operations procedures	. requires detailed analysis
. road disruption - changes in traffic volumes on arterials which cross alignment (4c)	. four-way comparison, preliminary design and construction procedures	. necessitates information on exact placement of alignment within right-of-way
. safe, convenient and direct pedestrian access to transfer points - directions of access and qualitative analysis of safety (4g)	. four-way comparison and preliminary design	. precise location of stations and design of stations not yet determined
. maintenance of conservation and recreation areas - acres of public open space and qualitative analysis of degree of disturbance (5a v)	. four-way comparison	. requires road right-of-way and design information

Objective/Criteria	Stage	Comments
. removal of mature trees - number of trees displaced by type and significance (5c)	. four-way comparison and preliminary design	. requires road right-of-way and design information
. potential for erosion and surface water pollution (5d)	. preliminary and final design and construction procedures	. most severe problems addressed in generation of feasible alignments
. consideration of social and economic groups sensitive to change - number of senior citizens and people on low incomes displaced (6a ii)	. four-way comparison	. precise counts of number and type of people displaced not possible until right-of-way boundaries established; likely to be minimal as routes primarily within existing rights-of-way
. loss of privacy or severance of public facilities or amenities - acres of land and replacment costs (6a iv)	. four-way comparison	. addressed in escarpment because some areas directly affected by tunnel; elsewhere requires right-of-way information - although likely to be minimal as routes primarily within existing rights-of-way

Objective/Criteria	Stage	Comments
. displacement, reduction or severance of private uses - acres displaced or made inaccessible by type (6a v)	. four-way comparison	. addressed in escarpment because some dwellings directly affected by tunnels, elsewhere requires right-of-way information; although likely to be minimal as routes primarily within existing road rights-of-way
. displacement - sites and facilities of historical, cultural and archaeological significance (6a vi)	. four-way comparison	. addressed in escarpment because some areas directly affected by tunnel; elsewhere requires detailed right-of-way information; although likely to be minimal as routes primarily within existing road rights-of way
. loss of privacy - number of residential properties, ground oriented and up to x floor level within distance y and visible from vehicles and stations (6b iv)	. four-way comparison	. requires further design information
. visual intrusion - number of dwelling units and floors of office buildings subject to over-shadowing (6b iv)	. four-way comparison	. requires further design information

Objective/Criteria	Stage	Comments
. visual barriers - number of dwelling units - from which views are blocked (6b vi)	. four-way comparison	. requires further design information
. intrusion of through traffic - percentage change in traffic on parallel streets, distances along local streets which would be used by feeder buses and cars and qualitative analysis of congestion (6b viii)	. four-way comparison	. requires precise station locations
. use of local streets for transit associated parking - qualitative analysis (6b ix)	. four-way comparison	. requires precise station locations
. restrictions to pedestrian and vehicle access to buildings and property (6c i)	. four-way comparison and preliminary design	. not possible to address until column placements determined

Objective/Criteria	Stage	Comments
. restrictions to access to community facilities, services and amenities - changes in number of neighbourhood residents within distance x or walking time y (6c ii), (6c xi), (6c xii)	. four-way comparison	. addressed in escarpment subarea for tunnel alignment - would only apply in subsequent analysis if tunnel alignments and for downtown alignments which close streets remain after shortlisting
. restrictions to delivery of services especially emergency vehicles (6c iii)	. four-way comparison	. would only apply in subsequent analysis if alignments with street closings or reroutings remain after shortlisting
. segregation of pedestrian/ vehicular traffic - pedestrian cross movement and safety (6c v)	. four-way comparison	. addressed in choice of station locations and design analysis
. severance of trails - provision of additional trails and walking paths along rights-of-way (6c vi), (6b iv)	. four-way comparison and preliminary design	. requires right-of-way information
. locate transfer points adjacent to areas suitable for high-density, high intensity uses - distance x - units, floor areas and employees (6c)	. four-way comparison	. analysis will be constrained to the extent that several of the development proposals are of a fairly general nature to this point

Objective/Criteria	Stage	Comments
. locate transfer points - in locations where development land available and more intensive development compatible with the character of the area-acreages (7c)	. four-way comparison	. dependent on precise location of stations
. functional and visual integration with proposed and possible uses - qualitative analysis (7d)	. four-way comparison and preliminary design	. necessitates precise identification of station locations
. pedestrian and vehicular connections with proposed and possible uses - distances between entry points and qualitative analysis (7e)	. four-way comparisons and preliminary design	. necessitates precise identification of station locations
. property acquisition costs - acres (8a)	. four-way comparison	. necessitates right-of-way information
. capital costs - detailed breakdown and distinctions such as net present value and cost by level of government, annualized or per mile (8b)	. four-way comparison	. necessitates right-of-way and design information

Objective/Criteria	Stage	Comments
. operations costs - costs, revenues, subsidy and cost performance (8c)	. four-way comparison	. only possible with ridership data
. property value depreciation - direction of change (8d)	. four-way comparison	. dependent on design - possible that there would be no property value depreciation
. loss of assessment - amount, percentage, potential for offsetting (8c)	. four-way comparison	. necessitates right-of-way information
. business disruption - qualitative analysis (8f)	. four-way comparison	. permanent disruption - necessitates detailed information on station locations and column placement . construction disruption addressed
. consistency with investment programs of other public agencies-qualitative analysis (8j)	. four-way comparison	. more detailed cost information would be needed before such a comparison could be made

Objective/Criteria	Stage	Comments
. flexibility to respond to changes in future land use patterns - qualitative analysis of differences in relative dependence on planned and proposed rather than existing or committed (9f)	. four-way comparison	. requires more detailed station location information

4.1.5 Other Criteria

The following criteria address considerations which are adequately addressed by other criteria.

Objectives	Criteria	Comments
. convenient access from above mountain to downtown (3C)	. travel time between terminal points	. addressed in location relative to downtown
	. population within distance x	. modified to percentage of population within distance x
	. population with distance x of transfer points	. addressed by percentage of population within distance x of alignment
. access between downtown and subregional centre (3d)	. distance between terminal point and subregional centre	. addressed in location relative to downtown

Objectives	Criteria	Comments
. access among downtown activity centres (3g)	. number of stations within downtown	. addressed by major activity centres within 900, 1,300 and 2,000 ft.
	. downtown route miles	
. service in suburban area (3b)	. number of suburban transfer points	. addressed by dwelling units within distance x of transfer points
	. suburban route miles per capita	
. displacement of people, jobs and buildings (6a i)	. number of people displaced	. possible to derive estimates for number of dwellings displaced
		. also addressed in qualitative analysis of potential problems in establishing stations
. visual intrusion (6b iv)	. qualitative analysis of relative severity of intrusion	. combined with qualitative analysis of opportunities for visual integration
. co-ordination with private investment decision-making (8k)	. qualitative analysis of relative consistency with patterns of demand for new office and retail space	. addressed in qualitative analysis of relative potential for development and redevelopment

4.2 Criteria Selection

The following criteria were selected by the planning, engineering and environmental teams as generally suitable for the comparative analyses of alternative alignments. These criteria have been grouped under the three major subareas, as the considerations on alignment selection did vary somewhat among study areas. In addition, the actual criteria which will be used will vary to some degree with different sets of alignment segments.

Furthermore, the planning, engineering and environmental teams will be modifying and refining (by developing indices for measuring the criteria) the criteria in the course of application. Changes or modifications to criteria will be recorded in the Task C4 Document - Comparison of Alignment Alternatives.

Criteria	Comments
4.2.1 Complete Alignments	
. accessibility to potential yard locations (2e)	. includes consideration of both number of potential yard locations and proximity to those locations
. travel time from downtown terminal point to subregional centre (3d)	
4.2.2 Mountain Area	
. location of alignment relative to downtown (3b)	
. impact on road capacity (4c)	
. location of alignment relative to development mass (3f)	. example of indice - suburban percentage on each side
. coordination of alignment with major activity centres (3e)	
. length of alignment within 50 ft. of residential development (6b)	
. dwelling units within 900, 1,300 and 2,000 ft. of stations	

Criteria	Comments
. length of route requiring either lane or sidewalk (4c)	. distinctions - road type, level of service, volumes
. number of surface bus routes intersected (4b)	
. bus miles of travel associated with each alignment (4e)	
. opportunities for provision of ancillary transportation facilities (2e)	
. relative degree to which views from Escarpment obstructed (5a vii)	
. relative differences in potential problems in establishment of transfer points (6a i) (6a iv) (6a v) (6a vi)	. although precise locations of stations not yet determined, it will be possible to give an overview (from a preliminary inspection of the general area where stations are to be established) of the potential of establishing stations without displacing existing uses
. relative ease with which facility can be integrated with streetscape (6b v)	
. relative extent to which conforms to Regional and Hamilton Official Plan designations and policies (7a)	
. relative potential for development or redevelopment in close proximity to transfer points (7b) (7c)	. based on a systematic analysis of all current development proposals . distinction - 1986 and 2001
. estimated construction costs (unit costs) (8b)	. detailed cost estimates dependant on determination of right-of-way and station locations
. relative differences in service relocation problems (8b)	

Criteria	Comments
. relative differences in potential for special approvals and implementation difficulties (8h)	
. relative differences in potential for incremental implementation (9a)	. examples of considerations - logical terminal points, development impacts
. relative differences in potential for expanding system (9b)	
4.2.3 Escarpment Area	
. impact on road capacity (4c)	
. relative differences in operational constraints (2a)	. examples of indices - length of gradient, emergency access to alignment
. number of local street closings (4c)	
. coordination of alignment with major activity centres (3e)	
. length of alignment within 50 ft. of residential development (6b)	
. number of surface bus routes intersected (4b)	
. length of route requiring either lane or sidewalk (4c)	
. relative differences in impacts on environmentally sensitive areas (5a ii) (5a iii)	
. distance through recreation and conservation areas (by type and number) (5a v)	

Criteria	Comments
. relative degree to which views to Escarpment obstructed (5a vii)	. two situations - views along visual corridors and views to Escarpment from homes at base of Escarpment
. quality of view for passengers (1f)	
. relative differences in extent to which soil stability represents a constraint to construction (5a viii)	. areas where problems most severe addressed in generation of feasible alignments
. number of uses displaced or made inaccessible (by type and location) (6a i) (6a iv) (6a v) (6a vi)	. distinctions - type - dwelling units, businesses, public facilities and historic sites
. impact on the appearance of the Escarpment from downtown (5a vi)	
. relative ease with which facility can be integrated with street-scape (6b v)	
. number of elementary school catchment areas severed (6c ii)	. would only apply to tunnel alignments
. number of service areas to other community facilities or services severed or made more indirect (6c ii)	
. number of emergency facility catchment areas severed (6c iii)	
. number of pedestrian paths severed or made more indirect (6c iv)	
. relative extent to which conforms to Regional and Hamilton Official Plan designations and policies (7a)	
. estimated construction costs (8b)	. relative units only
. relative differences in service relocation problems (8b)	

Criteria	Comments
. relative potential for special approval and implementation difficulties (8h)	
4.2.4 Downtown Area	
. coordination of alignment with major activity centres (3e)	
. square feet of commercial space within 700, 1,000 and 1,300 feet of terminal points (3c) (3e)	. data only available for combined office-retail floor space
. number of surface bus routes intersected (4b)	
. bus miles of travel associated with each alignment (4b)	
. opportunities for provision of ancillary transportation facilities (2e)	
. number of local street closings (4c)	
. length of routes requiring either lane or sidewalk (4c)	. distinctions - road type, level of service, volumes
. relative severity of construction disruption to road system (4c)	
. relative potential for problems in the establishment of transit transfer points (6a i) (6a iv) (6a v) (6a vi)	. general overview of potential for establishing transfer points without displacing existing uses
. relative ease with which facility can be integrated with streetscape (6b v)	. will include analysis of potential problems re building identity e.g. signs, numbers
. relative degree to which views obstructed along major visual corridors (6b vii)	. primary concern - Gore Park

Criteria	Comments
. relative extent to which conforms to Regional and Hamilton Official Plan designations (7a)	
. relative potential for development or redevelopment in close proximity to transfer points (7b) (7c)	
. estimated construction costs (unit costs) (8b)	
. relative differences in service relocation problems (8b)	
. relative potential for special approvals and other implementation difficulties (8h)	
. relative differences in potential for incremental implementation (9a)	
. relative differences in potential for expanding system (9b)	

4.3 Selected Criteria

The following criteria were selected by the planning, engineering and environmental teams after consultation with UTDC and the evaluation team.

4.3.1 Complete Alignment

The following criteria would only apply to the complete alignments.

Rapid Transit Service

- accessibility to potential yard locations
- travel time between terminal points

4.3.2. Mountain Area

The preliminary grouping for the selected criteria for the Mountain Area is as follows:

Transportation

- Access to Residential Areas
  - . location of alignment relative to downtown
  - . location of alignment relative to development mass
  - . dwelling units within various distances of possible stations
- Integration with Surface Transit
  - . number of surface bus routes intersected by alignment
  - . bus routes of travel associated with each alignment
  - . opportunities for provision of ancillary transportation facilities
- Impacts on Existing Transportation System
  - . impact on road capacity
  - . length of alignment requiring either lane or sidewalk

Social and Land Use

- Integration with Urban Structure
  - . integration with streetscape
  - . obstruction of views

- Development/Re-development
  - . planning policy conformity
  - . coordination of alignment with activity centres
  - . potential for development/re-development in close proximity to stations
- Community Impacts
  - . barriers - community structure and lifestyle
  - . length of alignment within 50 feet of residential development
  - . problems in establishing stations
- Costs
  - . relative unit costs
  - . service relocation problems
  - . potential implementation problems
- Flexibility
  - . flexibility for staging
  - . flexibility for expansion

4.3.3. Escarpment Area

The preliminary grouping of criteria for the Escarpment Area is as follows:

Transportation

- Operational Constraints
  - . length of gradiant
  - . emergency access to alignment
  - . quality of view for passengers
- Integration with Surface Transit
  - . number of surface bus routes intersected by alignment
  - . bus routes of travel associated with each alignment
  - . opportunities for provision of ancilliary transportation facilities

- Impacts on Existing Transportation System
  - . impact on road capacity
  - . length of alignment requiring either lane or sidewalk
  - . number of street closings

Geotechnical and Natural

- Soil stability
- Environmentally sensitive areas

Social and Land Use

- Integration with Urban Structure
  - . obstruction of views to escarpment
  - . appearance of escarpment
  - . integration with streetscape
- Development/Re-development
  - . planning policy conformity
- Community Impacts
  - . uses displaced
  - . distance through recreation and conservation areas
  - . access to community facilities and the provision of emergency services (4 criteria)
  - . length of alignment within 50 feet of residential development

Costs

- Unit costs
- Service relocation problems
- Potential implementation problems

4.3.4 Downtown Area

The preliminary grouping of criteria for the downtown subarea is as follows:

Transportation

- Integration with Surface Transit
  - number of surface bus routes intersected by alignment
  - bus routes of travel associated with each alignment
- Impacts on Existing Transportation System
  - impact on road capacity
  - length of alignment requiring either lane or sidewalk
  - road disruption (construction)
  - number of road closings

Social and Land Use

- Integration with Urban Structure
  - integration with streetscape
  - obstruction of views
- Development/Redevelopment
  - planning policy conformity
  - coordination of alignment with activity centres
  - potential for development/redevelopment in close proximity to stations
- Community Impacts
  - problems in establishing stations

Costs

- Unit costs
- Service relocation problems
- Potential implementation problems

Flexibility

- Flexibility for staging
- Flexibility for expansion

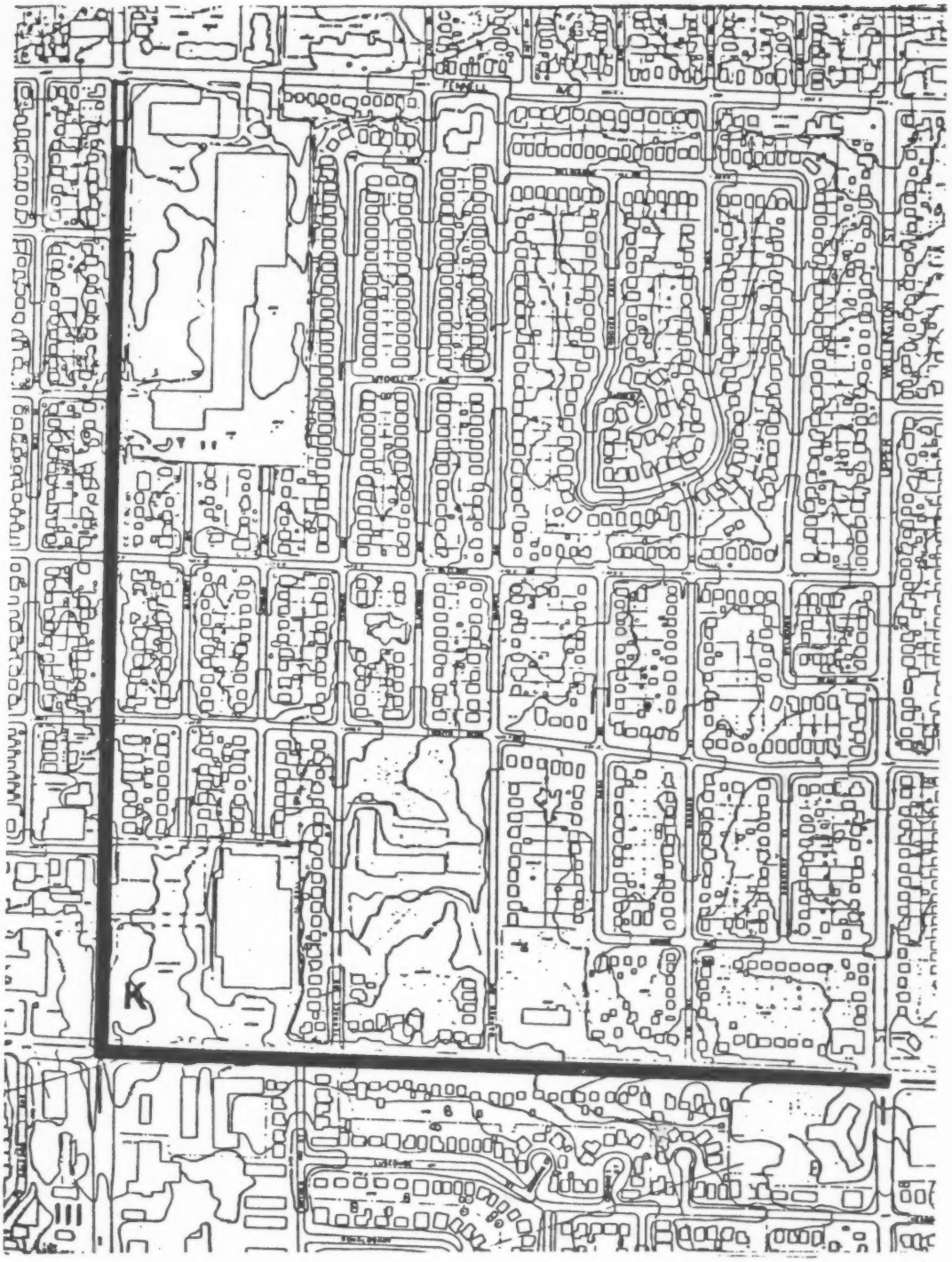

FIGURE 14 - K SEGMENTS